CLAIMS

1. A swivel joint apparatus for supplying utilities to a rotating building rotatable about a central axis, comprising:

a first, fixed member for securing to a fixed base of a rotating building to extend co-axially with the central axis of rotation of the building, the first member having a plurality of annular chambers each having an opening directed away from the first member;

a second member rotatably mounted on the first member for securing to a portion of the rotating building, the second member extending over the chamber openings in the first member to form rotating wall portions closing the respective chambers;

a plurality of seals between the first and second member for sealing the chambers;

the first member having a plurality of first ports connected to the respective chambers for connection to fixed utility lines in the base of the building; and

the rotatable member having a plurality of second ports connected to the respective chambers for connection of utility fluids to and from the rotating part of the building.

2. The apparatus as claimed in claim 1, wherein the first member comprises an inner, fixed spindle having a series of axially spaced, outwardly projecting annular flanges defining said annular chambers between each adjacent pair of

flanges, each flange having an outer peripheral edge and at least one ring seal mounted on the peripheral edge of each flange, the flanges having a predetermined outer diameter; and

the second member comprises an outer casing rotatably mounted on the spindle for securing to part of the rotating building, the casing having an inner diameter substantially equal to the outer diameter of the flanges, the casing forming an outer wall of each of the annular chambers and being in rotatable sealing engagement with each of the ring seals to seal the chambers;

3. The apparatus as claimed in claim 2, wherein the spindle has a lower end wall, said first ports extending through said lower end wall, and a bore extending from each port through the spindle to a respective annular chamber, whereby each chamber is connected to at least one first port in the lower end wall; and

the second ports are provided at axially spaced locations on said casing, with at least one second port communicating with each of said annular chambers.

4. The apparatus as claimed in claim 2, wherein each flange has an outwardly directed, annular sensor chamber spaced outwardly from the ring seal, the outer casing has a plurality of holes including at least one hole aligned with each of the sensor chambers, and a plurality of fluid sensors are mounted in the outer casing to project through the respective holes to sense any leakage of fluid past any of the seals.

5. The apparatus as claimed in claim 1, wherein one of the annular chambers comprises a sewer chamber for connecting rotating sewer lines within the rotatable building to fixed sewer lines within the base, the first member having more than one port communicating with the sewer chamber and the second member having a plurality of ports communicating with the sewer chamber.

6. The apparatus as claimed in claim 5, wherein the annular chambers further include a water chamber for supply of water from a fixed water line in the base to water supply lines within the rotating building, and a gray water chamber for connecting at least one gray water drain line within the rotating building to gray water drain outlet line in the base.

7. The apparatus as claimed in claim 6, wherein the annular chambers include a gas supply chamber for connecting a gas supply line in the base to gas supply lines within the rotatable building.

8. The apparatus as claimed in claim 2, wherein the annular flanges include two end flanges at opposite ends of the spindle forming an outer end wall of respective opposite end chambers, and a plurality of spaced intermediate flanges separating adjacent chambers along the length of the spindle, each intermediate flange having a pair of spaced ring seals projecting outwardly from its peripheral edge for rotatable sealing engagement with said outer casing.

9. The apparatus as claimed in claim 8, wherein each intermediate flange has a sensor chamber between the pair of ring seals, and each end flange has a sensor chamber outside the ring seal mounted on the respective end flange, and a plurality of fluid sensors are mounted on the outer casing to extend into the respective sensor chambers to detect leakage of fluid past any of the ring seals, the sensors having outputs for connection to a control unit within the rotatable building to provide an alarm signal in the event of failure of any of the seals.

10. The apparatus as claimed in claim 9, wherein at least two sensors are provided in each sensor chamber.

11. The apparatus as claimed in claim 9, wherein at least one of the annular chambers comprises a gas supply chamber for communicating a gas supply from the fixed base into the rotating part of the building, at least one chamber adjacent the gas supply chamber is a water chamber, and at least one water sensor and one gas sensor is provided in the sensor chamber between the gas supply chamber and water chamber.

12. The apparatus as claimed in claim 1, including an electrical swivel assembly mounted above said first and second members, the electrical swivel assembly comprising a fixed contact core secured to the first member and an outer rotating contact portion secured to the second member, the first and second members and contact core having aligned central through bores for passageway of fixed electrical power supply lines from the base of the building

to the contact core, and the outer contact portion having contacts for connection to power supply lines supplying power to fixtures within the rotating building.

13. The apparatus as claimed in claim 12, including a rotary connector mounted on said electrical swivel assembly for supply of electrical services to the rotating building, the rotary connector having a fixed part for connection to fixed electrical service lines extending through the aligned central through bores of the first and second members and electrical contact core, and a rotary part rotatably mounted on the fixed part and having conductors for connection to electrical service lines within the rotating building, the rotary part being coupled to the outer rotating contact portion of the electrical swivel.

14. The apparatus as claimed in claim 1, wherein the first and second parts comprise a lower fixed circular plate and an upper circular plate rotatably mounted on the lower plate, the annular chambers comprising a series of radially spaced, upwardly directed annular grooves in said lower plate.

15. The apparatus as claimed in claim 14, including an annular sensor chamber between each adjacent pair of annular chambers, and an annular sensor chamber spaced radially outwardly from the outermost annular utility chamber, and a plurality of upwardly facing circular seals mounted on said lower plate for rotatable sealing engagement with said upper plate, each seal being located between a respective sensor chamber and utility chamber.

16. A rotatable building structure, comprising:

a fixed base;

a building rotatably mounted on the fixed base for rotation about a central axis of rotation coaxial with the building and base;

the building including a central elevator shaft projecting upwardly from the base through the height of the building and having a lower end rotatably mounted on the base;

the base having an outer mounting rail extending in a circular path and spaced outwardly from the elevator shaft;

the building having a lower wall having a series of spaced pairs of bearings running along opposite sides of said mounting rail for rotatable support of the building as it rotates on said base; and

a swivel joint assembly mounted in the base coaxially with said elevator shaft and beneath said lower wall for rotatably connecting fixed utility lines extending into the base with corresponding utility lines secured within the rotating building.

17. The structure as claimed in claim 16, wherein the base has a chamber extending below ground level, the chamber having a drain outlet, the rotatable building having a roof, and a drain line extending from the roof downwardly alongside the elevator shaft and into said chamber, the drain line having an outlet end in said chamber for directing water collected on said roof into said drain outlet.

18. The structure as claimed in claim 17, wherein the swivel joint assembly is mounted in said chamber.

19. The structure as claimed in claim 16, wherein the swivel joint assembly comprises a first, fixed member secured to the fixed base and extending co-axially with the central axis of rotation of the building, the first member having a plurality of annular chambers each having an opening directed away from the first member, and at least one ring seal between each adjacent pair of annular chambers, a second member tied to the lower wall of the rotatable building and rotatably mounted on the first member for rotatable sealing engagement with said ring seals, the second member extending over the chamber openings in the first member to form rotating wall portions closing the respective chambers, the first member having a plurality of first ports connected to the respective chambers and to fixed utility lines in the base of the building; and the rotatable member having a plurality of second ports connected to the respective chamber, including at least one port connected to each chamber, each second port being connected to a respective utility line extending into said rotatable building.

20. The structure as claimed in claim 19, wherein the first member comprises a fixed central spindle having a series of spaced, radially outwardly projecting annular flanges forming said annular chambers between said flanges, each flange having an outer peripheral edge and at least one of said ring seals mounted on said peripheral edge, and the second member comprises an outer casing rotatably mounted on said spindle and having a predetermined inner

diameter for rotatable sealing engagement with said ring seals, whereby the casing forms an outer rotating wall portion of each of the annular chambers.

21. The structure as claimed in claim 20, wherein each flange has an outwardly directed, annular sensor chamber spaced from said ring seal, and the outer casing has a series of sensors including at least one sensor projecting into each of the sensor chambers for detecting leakage past said ring seal.

22. The structure as claimed in claim 21, wherein the flanges including an upper end flange, a lower end flange, and a series of intermediate flanges spaced between said upper and lower end flanges, each end flange having one ring seal and one sensor chamber, and each intermediate flange having a pair of ring seals with the sensor chamber located between the ring seals, whereby sensors extending into the sensor chambers in respective intermediate flanges detect leakage from the adjacent chambers on opposite sides of said intermediate flanges.

23. The structure as claimed in claim 19, including an electrical swivel assembly mounted on an upper end of the first and second members, the electrical swivel assembly comprising an inner contact core secured to of the first, fixed member, and an outer rotating contact portion secured to the second member, the members and contact core having a central through bores, and fixed electrical power supply lines extending from the base of the structure through the central through bore being connected to the inner contact core of the

electrical swivel assembly, the outer contact portion having contacts connected to electrical service lines within the rotating building.

24. The structure as claimed in claim 23, wherein the rotating building includes a first set of electrical service lines for transmission of electrical service signals to and from the building, and the swivel assembly includes a rotary electrical connector mounted on said electrical swivel assembly for connection of the first set of electrical service lines to a second set of fixed electrical service lines in the base of the structure, the rotary electrical connector having a fixed part mounted on top of the inner fixed contact core of the electrical swivel assembly and a rotating part rotatably mounted on the fixed part, the rotating part having first contacts connected to said first set of electrical service lines, and the fixed part having second contacts rotatably connected to said first contacts, said second set of fixed electrical service lines including conductive lines extending through said aligned central through bores of said spindle and contact core and connected to said second contacts of said rotary connector.

25. The structure as claimed in claim 24, wherein said rotary electrical connector comprises a low noise mercury swivel.

26. The structure as claimed in claim 16, wherein the mounting rail comprises an inverted T-section rail and the lower wall of the building has a series of spaced wobble boxes, two pairs of bearings being mounted in each of the wobble boxes and each pair of bearings comprising an inner bearing running along the inside of the rail and an outer bearing running along the outside of the rail.

27. A method of rotatably connecting fixed utility lines beneath a rotatable building to corresponding utility lines secured within the building and rotatable with the building, comprising the steps of:

connecting a plurality of fixed utility lines in a fixed base of a rotatable building to inlet ports at the lower end of a fixed member secured to the fixed base and extending co-axially with the axis of rotation of the building, the fixed member having a plurality of annular chambers with outwardly facing openings, each port being connected to a respective chamber;

connecting a second member rotatably mounted on the fixed member to part of the rotating building so that the second member rotates with the building, the second member forming a rotating wall portion closing the opening in each of the annular chambers; and

connecting a plurality of utility lines secured within the rotatable building to respective ports in the second member, at least one port in the outer casing communicating with each of the annular chambers.

28. The method as claimed in claim 27, including the step of providing at least one seal between each pair of annular chambers for rotatable sealing engagement with said second member to seal each of the annular chambers.

29. The method as claimed in claim 28, including the steps of providing at least one sensor spaced outwardly from each of the seals for detecting fluid leakage past the seal, connecting the outputs of the sensors to a control unit

within the rotatable building, and providing an alarm signal in the event of failure of any of the seals.

30. The method as claimed in claim 27, including the steps of sealing an inner fixed contact core of an electrical swivel assembly to the fixed member at a location above the fixed and second members, securing an outer contact portion of the electrical swivel assembly to the second member, whereby the outer contact portion rotates with the second member, connecting a plurality of fixed electrical power lines in the base to the inner contact core, and connecting a plurality of electrical power lines within the rotatable building to the outer contact portion of the electrical swivel assembly.

31. The method as claimed in claim 30, including the steps of mounting a fixed part of a low noise rotary electrical connector on top of the fixed contact core of the electrical swivel assembly, connecting contacts on the fixed part to fixed electrical service lines extending from the base through the fixed and second members and contact core, and connecting contacts on an upper, rotary part of the rotary electrical connector to electrical service lines secured to electrical devices within the rotatable building, whereby the upper rotary part rotates with the building.